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Moriarty et al.

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(54) **INTRUSION DETECTION**

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G08B 13/196 (2006.01)
G07C 9/00 (2006.01)

(52) **U.S. Cl.**

CPC ***H04N 7/18*** (2013.01); ***G07C 9/00007*** (2013.01); ***G08B 13/19671*** (2013.01); ***G08B 13/19695*** (2013.01); ***H04N 7/183*** (2013.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

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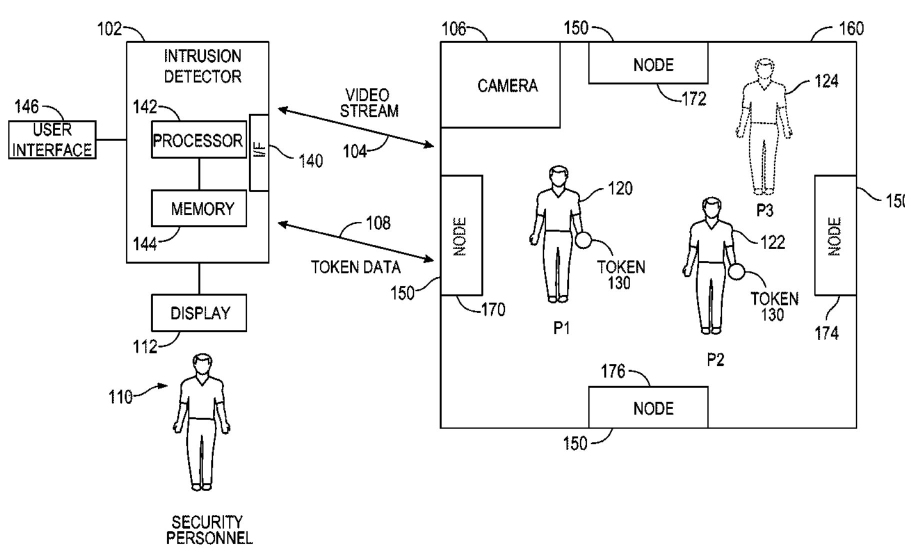
(57) **ABSTRACT**

Disclosed is an intrusion detector that may be used to determine if a person is authorized or unauthorized based upon the person carrying a token in an area being monitored for security. The intrusion detector may include: an interface and processor. The interface may receive video stream data from a camera and token data. The processor may execute operations including: receiving the video stream data and the token data and determining whether a person in the video stream data is carrying a token based upon whether the token data is associated with the person. If the person is determined to not be carrying a token, the person may be displayed as unauthorized.

37 Claims, 5 Drawing Sheets



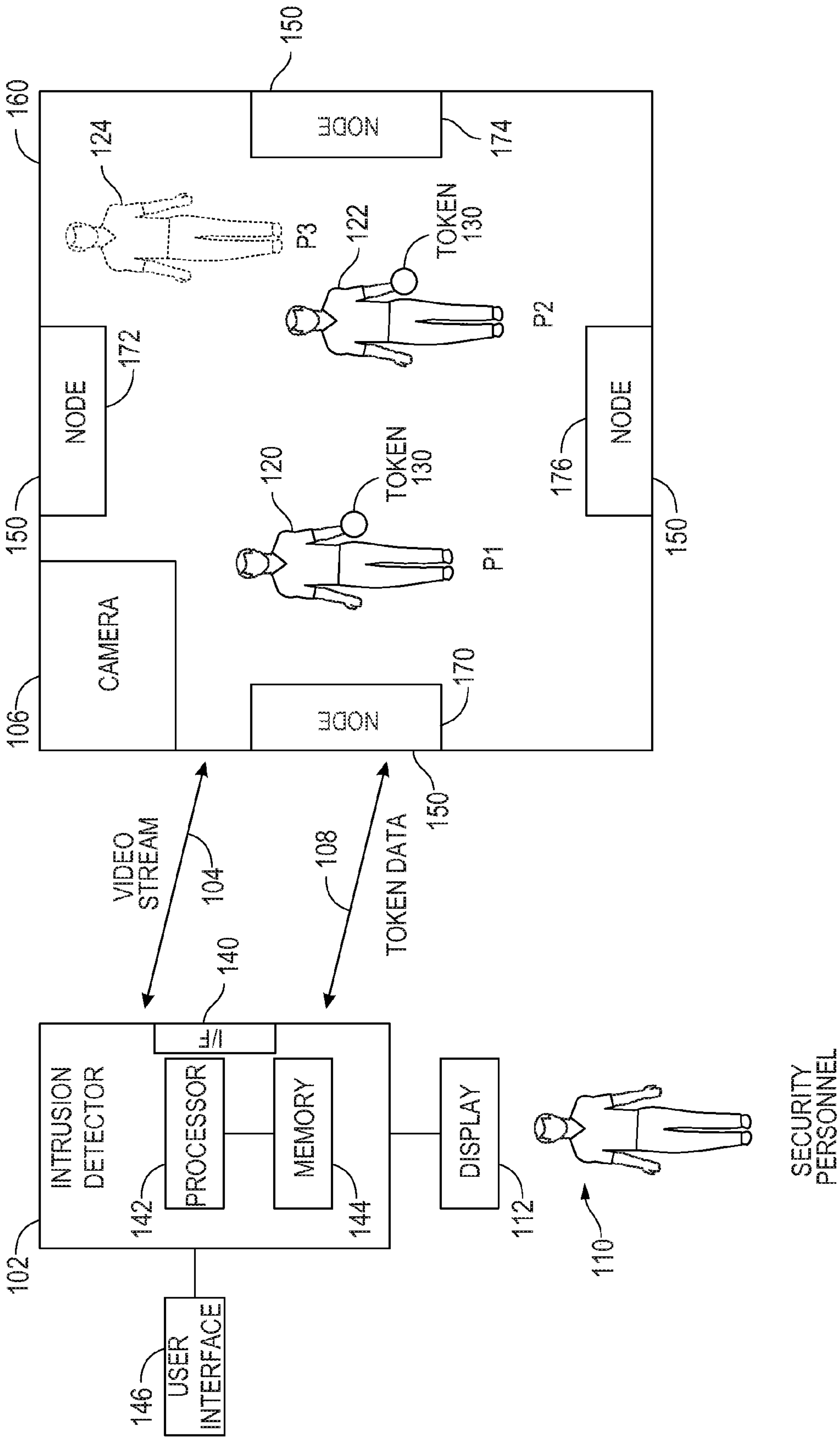

160
124
150
NODE
174
P3
122
TOKEN
130
P2
NODE
172
TOKEN
130
120
150
NODE
176
150
P1
CAMERA
106
NODE
170
150
VIDEO
STREAM
104
108
TOKEN DATA
140
I/F
INTRUSION
DETECTOR
PROCESSOR
MEMORY
DISPLAY
102
142
144
112
110
SECURITY
PERSONNEL
USER
INTERFACE
146

FIG. 1

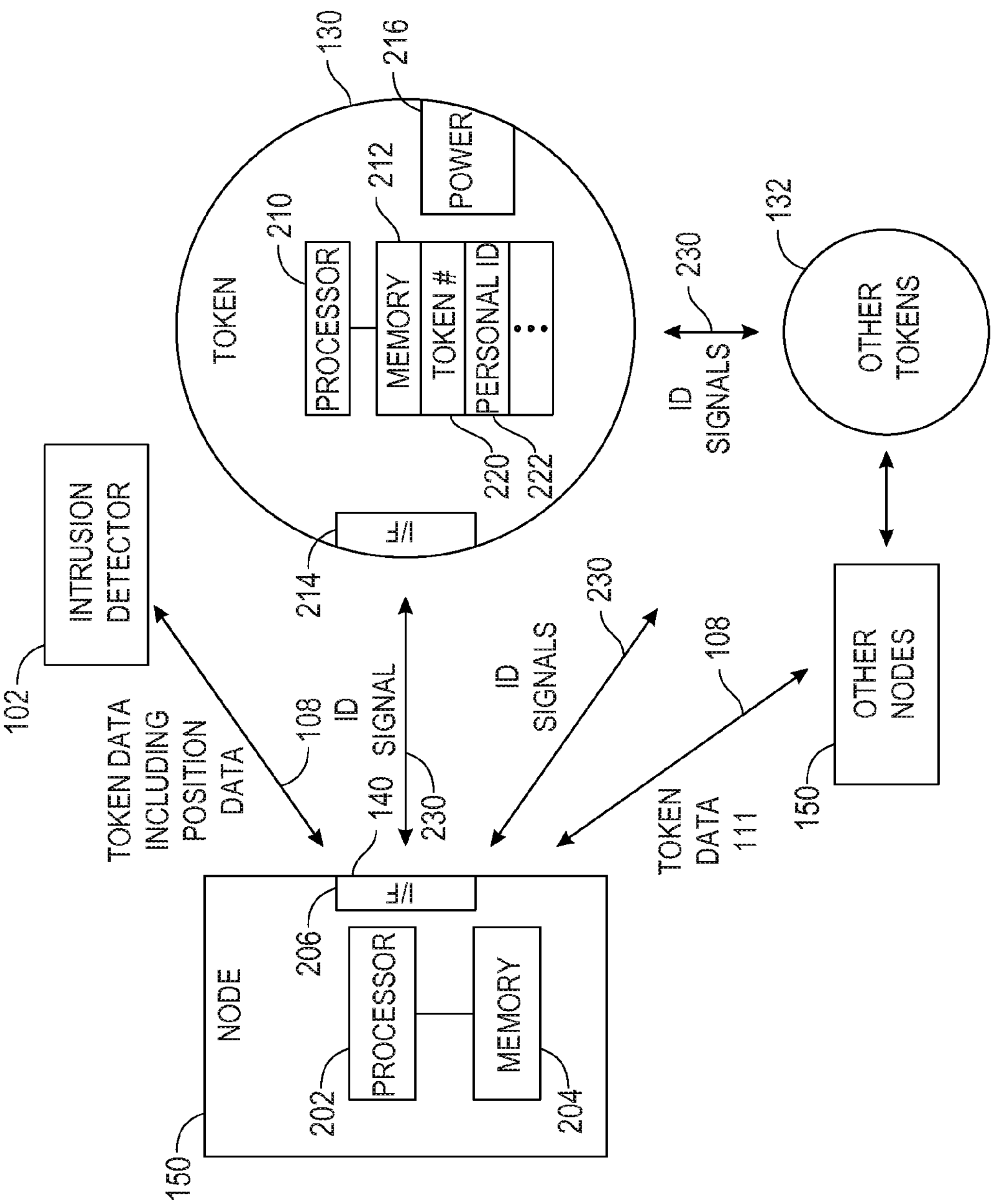

TOKEN
PROCESSOR
MEMORY
TOKEN #
PERSONAL ID
POWER
I/F
130
210
212
216
220
222
214
INTRUSION DETECTOR
102
ID SIGNALS
230
OTHER TOKENS
132
TOKEN DATA INCLUDING POSITION DATA
108
ID SIGNAL
140
230
ID SIGNALS
230
108
OTHER NODES
150
TOKEN DATA 111
NODE
PROCESSOR
MEMORY
I/F
206
202
204
150

FIG. 2

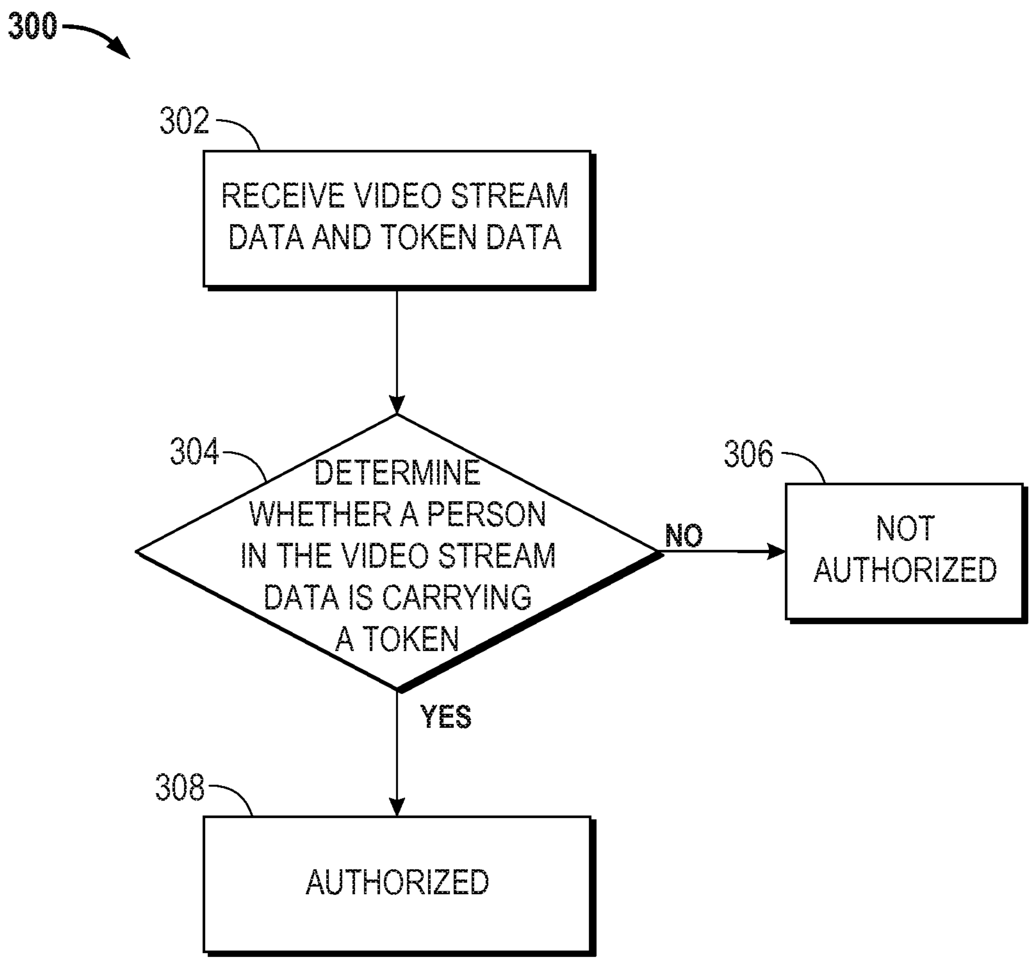

300
302
RECEIVE VIDEO STREAM DATA AND TOKEN DATA
304
DETERMINE WHETHER A PERSON IN THE VIDEO STREAM DATA IS CARRYING A TOKEN
NO
306
NOT AUTHORIZED
YES
308
AUTHORIZED

FIG. 3

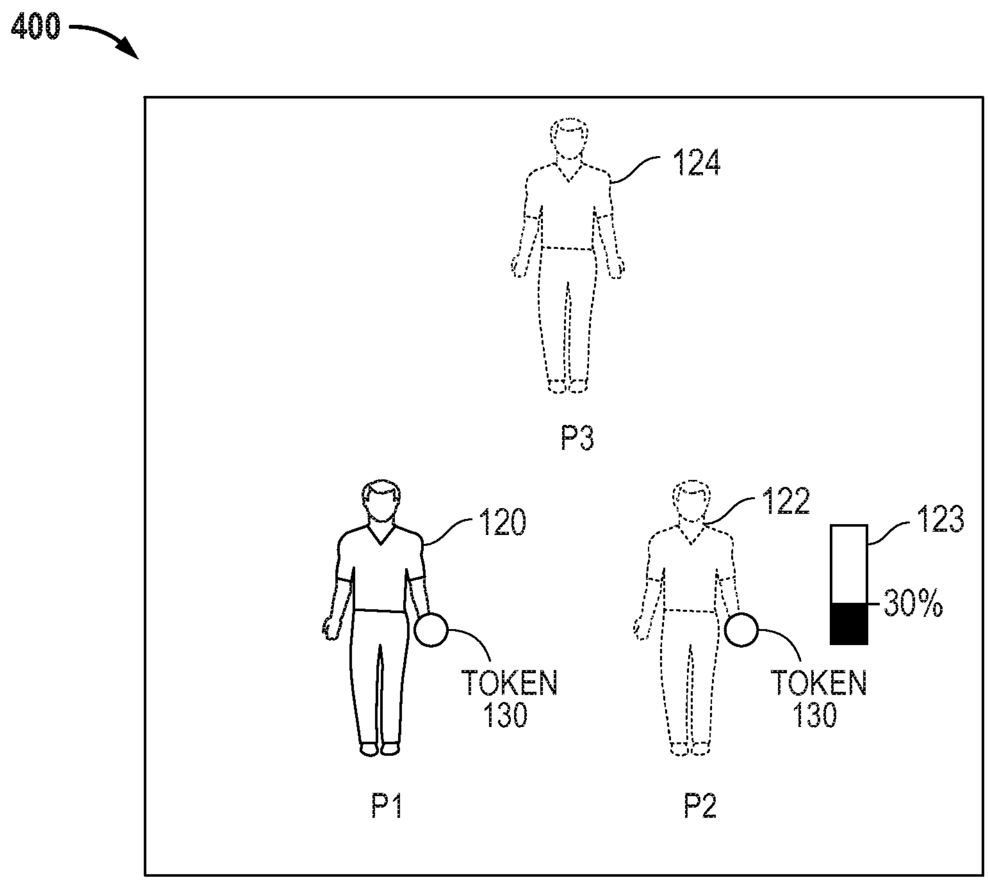


FIG. 4

500

		510	512	514	516	
120	P1	TOKEN YES	P1 POSITION CORRECT	BIOMETRIC DATA MATCHES	AUTHORIZED	• • •
122	P2	TOKEN YES	P2 POSITION CORRECT	BIOMETRIC DATA NOT MATCHING	NOT AUTHORIZED	• • •
124	P3	TOKEN NO	P3 POSITION NONE	BIOMETRIC DATA NOT MATCHING	NOT AUTHORIZED	• • •
	• • •	• • •	• • •	• • •	• • •	• • •

FIG. 5

INTRUSION DETECTION

BACKGROUND

1. Field

The present invention relates generally to intrusion detection.

2. Relevant Background

Common intrusion detection systems primarily utilize a camera for security purposes and are not very effective in populous environments (e.g., corporate and government buildings/offices/structures/compounds, military installations, airports, hospitals, universities, etc.). This is because there is no way for a security person viewing the display from the camera to differentiate between authorized people and unauthorized people.

Further, security systems that utilize tokens to allow for the entry and exit of authorized people into and out of secure areas, are also ineffective in that there is no way for the display to verify to a security person whether a person actually has a token once they are in the secure area. For example, swipe cards are often used as a token to let people through a door and into a building, however, other people often tail-gate in as well. Once a person is in a building, they may be seen on a display from a camera, but there is no way for a security person viewing them to determine whether or not they have an authorized token.

SUMMARY

Aspects of the invention may relate to an apparatus, method, and system for utilizing an intrusion detector that is used to determine if a person is authorized or unauthorized based upon the person carrying a token in an area being monitored for security. The intrusion detector may include: an interface and processor. The interface may receive video stream data from a camera and token data. The processor may execute operations including: receiving the video stream data and the token data and determining whether a person in the video stream data is carrying a token based upon whether the token data is associated with the person. If the person is determined to not be carrying a token, the person may be displayed as unauthorized.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram of a system in which aspects of the invention related to an intrusion detector may be practiced.

FIG. **2** is a block diagram of the intrusion detector interfacing with a token and a node.

FIG. **3** is a flow diagram illustrating a process implemented by the intrusion detector to determine whether a person is authorized or unauthorized.

FIG. **4** is a diagram illustrating an example of a display of authorized and unauthorized people.

FIG. **5** is a diagram of a table providing examples of data utilized to determine if a person is authorized or unauthorized.

DETAILED DESCRIPTION

The word "example" or "exemplary" is used herein to mean "serving as an example, instance, or illustration." Any aspect or embodiment described herein as "exemplary" or as an "example" in not necessarily to be construed as preferred or advantageous over other aspects or embodiments.

With reference to FIG. **1**, FIG. **1** is block diagram of a security system in which aspects of the invention may be practiced. As will be described, aspects of the invention relate to an intrusion detector **102** that receives video stream data **104** from a camera **106**, in combination with token data **108** from a node **150**, such that a security person **110** viewing the video stream data **104** on a display device **112** can determine whether a person (e.g., P**1** **120**, P**2** **122**, and P**3** **124**), is carrying a token **130**. If a person is not carrying a token **130**, the person can be identified as unauthorized and the security person **110** can take appropriate action.

In one aspect, intrusion detector **102** may include: an interface (I/F) **140**; a processor **142**; a memory **144**; a user interface **146**; and the display device **112**. I/F **140** may be configured to receive video stream data **104** from camera **106** and token data **108** from node(s) **150**. Processor **142** may be configured to execute operations including: receiving video stream data **104** and token data **108**; and determining whether a person (e.g., **120**, **122**, and **124**) in the video stream data **104** is carrying a token **130** based upon whether token data **108** is associated with the person. If the person is determined to not be carrying a token **130**, then the person may be identified as being unauthorized to the security person **110**. For example, display device **112** may display the person as being unauthorized to security person **110** in the video feed. As an example, the person may be designated on the display device **112** in dashed lines (e.g., person **124**) or by a certain color (e.g., red for unauthorized; green for authorized, etc.).

On the other hand, if processor **142** of intrusion detector **102** determines that the person (e.g., person **120**, **122**) is carrying a token **130**, then the person may be displayed as being authorized on the display device **112** to security person **110**. For example, the person **120**, **122** may be shown in full lines and/or colored green, etc. It should be apparent to those of skill in the art that there are many different types of display methods that may be utilized.

Further, it should be appreciated that intrusion detector **102** may be any type of suitable computing device (e.g., specialized security computer system, personal computer, server computer, laptop computer, mobile device, non-mobile device, wireless device, smart phone, cell phone, tablet, personal digital assistant (PDA), etc.) having a processor **142** and memory **144** to implement the previously described functionality. User interface **146** may be any suitable type of input mechanism, e.g., keyboard, keypad, touch-screen, voice recognition microphone, etc. Further, I/F **140** may be a suitable wired or wireless interface. When implemented as a wireless interface, I/F **140** may include suitable transceiver components (e.g., a wireless transmitter and receiver) to send and receive data.

In one particular aspect, a node **150** may be used to generate token data **108** that is transmitted to intrusion detector **102**. The token data **108** may be based upon an identification signal received from the token **130**, as well as, position data that is calculated to estimate the position of the token **130**. For example, the token data **108** may include both position data associated with the token **130**, as well as, identification data associated with a person (e.g., a token number, a personal ID, etc.). In this way, based upon the position data of the token data **108** and the video stream data **104**, intrusion detector **102** can map the position data of the token **108** with the person on the video stream such that, for example, person **120** can be determined and shown to be carrying a token **130** based upon position data associated with the token **130** and the person **120** through the display device **112** to a security person **110**.

In one embodiment, the position of the token **130** may be calculated or estimated by the node **150** and the node **150** may transmit this token data **108** (e.g., the token position) to the intrusion detector **102**, as will be described. In another embodiment, token **130** may calculate its own position data and transmit this data directly to the intrusion detector **102** or through a node **150** to the intrusion detector **102**.

Further, as previously described, based upon this, processor **142** of the intrusion detector **102** may determine if a person is associated with token data **108** or not associated with token data **108**. In one embodiment, the intrusion detector **102** may associate a person with a token **130** based upon the actual position of the token **130** as determined by a node **150**. The intrusion detector **102** may display a person **120** on the display device **112** based upon the video stream **104** from the camera **106** in combination with token data **108** (e.g., the position data of the token **130**) such that if a person has no token data associated with them (e.g., no position data), the person may be shown on the display device **112** in dashed lines (e.g., person **124**) or by a certain color (e.g., red for unauthorized, etc.) to the security person **110**.

On the other hand, if processor **142** of intrusion detector **102** associates a person with token data **108** by mapping the position data of the token **130** with person in the video stream **104** such that the person (e.g., person **120**, **122**) is determined and displayed as carrying a token **130**, then the person may be displayed as being authorized on the display device **112** to the security person **110**. For example, the person **120**, **122** may be shown in full lines and/or colored green, etc.). It should be apparent to those of skill in the art that there are many different types of display methods that may be utilized.

Also, it should be appreciated that a person "carrying" a token merely refers to a person having a token in their presence (e.g., in a pocket, being held, on a wristband, on a necklace, etc.).

As an example, as shown in FIG. **1**, various nodes **150** may be mounted to walls of a room **160**. It should be appreciated that various nodes **150** may be located at a multitude of different locations (walls, ceilings, floors, tables, furniture, other locations, etc.) throughout a building (e.g., halls, rooms, auditoriums, airport, etc.) or outside a building (e.g., parking lot, walkways, etc.). In particular, each of these nodes **150** may have a known position location. Additionally, each node may be powered by a power supply (e.g., an already existing electrical plug).

With additional reference to FIG. **2**, a block diagram of components of the security system is illustrated. As an example, a node **150** may be a computing device having a processor **202** and a memory **204** to implement various functions including calculating and transmitting token data such as, position data and ID information of tokens **130**,**132**, to the intrusion detector **102**. Node **150** may include an I/F **206** (e.g., wireless or wired) to receive ID signals **230** from tokens **130**,**132** and to transmit token data **108** to intrusion detector **102** and to other nodes. When implemented as a wireless interface, I/F **206** may include suitable transceiver components (e.g., a wireless transmitter and receiver) to send and receive data.

Further, as an example, a token **130** may be a computing device having a processor **210** and a memory **212** to implement various functions. Memory **210** of token **132** may store various identifiers such as: a token number **220**; a personal ID **222**; as well as various other identifiers. Token **130** may include an I/F **214** (e.g., wireless or wired—but typically wireless) to transmit and receive ID signals **230** to and from other tokens **132** and nodes **150**. When implemented as a wireless interface, I/F **214** may include suitable transceiver components (e.g., a wireless transmitter and receiver) to send and receive data.

Various types of ID signals **230** may be used. For example, an ID signal **230** may merely identify a particular number for a token (e.g., token ID #**220**) to identify the token **130**. However, tokens **132** may also include a personal ID **222** that identifies a particular person that is designated to utilize the token **130**. As an example, a person's name, age, height, weight, job title, check-in time, etc., may be a personal ID **222**. Further, tokens at predetermined intervals (e.g., every 15 seconds) may transmit out their ID signal **230**. A token **130** may include a power source **216**, such as a battery, so that it is portably powered. As an example, a token **130** may be a smart wireless device that does not require a lot of computational power such that it is inexpensive, light weight, and very portable.

In one aspect, nodes **150**, under the control of a position determining program (e.g., such as, a triangulation program) implemented by processor **202**, may calculate the positions of tokens **130**, **132** and transmit the position data of the tokens (as token data **108**) to the intrusion detector **102**. In order to calculate the positions of tokens **130** and **132**, nodes **150** may communicate token data **111** with each other to calculate the position of identified tokens **130**, **132** in a triangulation methodology. Such token data **111** may include time to receive an ID signal **230** from a particular token **130**, **132**.

It should be appreciated that the nodes **150** have fixed positions and therefore have predefined positions which may be pre-programmed into each node **150** and each node knows the other nodes **150** positions. Therefore, the nodes **150** may receive ID signals **230** from the tokens **130**, **132** and may calculate the position of each token **130**, **132** such that all of the positions of the tokens **130**, **132** can be determined based upon the known position locations of the nodes **150** and the received ID signals **230** from the tokens **130**, **132** based upon a triangulation methodology.

As one example, the nodes **150** may implement a triangulation program to determine the position of a token. Referring back to FIG. **1**, node **170** may receive an ID signal from token **130** of person **120** and may calculate the time to receive the ID signal. Further, node **172** may also receive the ID signal and may calculate the time to receive the ID signal from token **130** of person **120** and may communicate this token data to node **170**. In particular, based upon the known positions of nodes **170** and **172** and the transmit times of the ID signals from token **130** of person **120** to the nodes **170** and **172**, node **170** may estimate the position of token **130** from person **120**. Further, additional nodes **174** and **176** may also transmit token data to node **170** and in combination with their known positions can further increase the accuracy of the estimate of the position of token **130** of person **120**. Moreover, the position estimates for other tokens **130** for other people (e.g., person **2 122**) already made may also be utilized in triangulation techniques for better position estimates by the nodes **150** for other tokens **130**. Additionally, tokens **130** may communicate with one another in token to token communication and to the nodes **150** to aid in token position estimation by the nodes **150** via triangulation methods. Furthermore, tokens **130** may estimate their own positions and communicate with one another in token to token communication to aid in token position estimation.

In this way, by tokens **130** (that are moving) communicating with various nodes **150** (having fixed and known positions) that communicate token data (e.g., time to receive an ID signal from a particular token) with one another, an ad-hoc mesh network is provided in which by utilizing triangulation techniques the positions of tokens **130** may be estimated by nodes **150** and transmitted as position token data **108** to the intrusion detector **102**. It should be appreciated that a wide variety of differing types of position calculation techniques may be implemented by the nodes **150** and that this is just one example. Further, the intrusion detector **102** may also calculate the position estimates of the tokens **130** based upon data from the nodes **150** in addition to the nodes or instead of the nodes. Also, as previously described, in one embodiment, in the case of more complex tokens, the tokens may calculate their own position estimation data. In summary, as previously described, by utilizing triangulation techniques, an ad-hoc mesh network is created in which nodes **150** and tokens **130** communicate with one another such that position data for each token **130** may be accurately estimated.

Also, it should be appreciated that this is just one example of nodes **150** communicating in a room to implement position determination techniques and that these techniques may be implemented by nodes at a variety of different locations (walls, ceilings, floors, tables, furniture, other locations, etc.) throughout a building (e.g., halls, rooms, auditoriums, airport, etc.) or outside a building (e.g., parking lot, walkways, etc.).

With brief additional reference to FIG. **3**, FIG. **3** shows a flow diagram illustrating a process **300** to determine whether a person is authorized or not authorized based upon the use of tokens. At block **302**, intrusion detector **102** may receive video stream data **104** and token data **108** from nodes **150**. At decision block **304**, intrusion detector **102** may determine whether a person (**120**, **122**, **124**) in the video stream data **104** is carrying a token **130** based upon whether token position data is associated with a person. For example, if the person is determined to not be carrying a token **130** based upon the token position data, then the person may be identified as being unauthorized to the security person **110** (block **306**). For example, display device **112** may display the person as being unauthorized to security person **110** in the video feed. As an example, the person may be designated on the display device **112** in dashed lines (e.g., person **124**) or by a certain color (e.g., red for unauthorized).

On the other hand, if at decision block **304**, the intrusion detector **102** determines that the person **120**,**122** is carrying a token **130**, then the person is displayed as being authorized on display device **112** to the security person **110** (block **308**). For example, the person **120**,**122** may be shown in full lines and/or colored green, etc.

In addition to the use of token data **108** (e.g., position token data), the intrusion detector **102** may also utilize biometric data to determine whether persons or authorized or not authorized.

In an additional aspect, if a person **120** is determined to be carrying a token **130** by the by the position data of the token **130** being associated with the person **120** of the video stream **104** by processor **142** of intrusion detector **102**, then intrusion detector **102** may further execute operations including comparing measured biometric data of the person **120** carrying the token to stored biometric data for the person assigned to the token. As an example, memory **144** of the intrusion detector **102** may store biometric data for authorized persons.

If the measured biometric data of the person **120** carrying the token **130** matches the stored biometric data for the person **120** assigned to the token, the person **120** may be identified as authorized and the authorized person may be displayed on the display device **112** to a security person **110** as authorized, as previously described.

However, as will be described, if the measured biometric data of the person carrying the token does not match the stored biometric data for the person assigned to the token, the person may be identified as unauthorized and the unauthorized person may be displayed on the display device to a security person as unauthorized. The biometric data may include facial recognition, height, weight, voice, etc. It should be appreciated that a wide variety of different types of biometric data may be utilized and that these are only examples.

Biometric data may be determined by known methodologies by intrusion detector **102** under the control of processor **142** to utilize the video stream data **104**, along with other data (e.g., sound data) transmitted to the intrusion detector **102** by other sources, to determine biometric data related to facial recognition, height, weight, voice, etc. This biometric data utilized in combination with token data provides additional security in determining authorized and unauthorized persons. Examples of this will be hereinafter described.

With additional reference to FIGS. **4** and **5**, examples of the intrusion detector **102** determining whether persons in the video stream **104** should be identified as authorized or not authorized based upon token data **108** and biometric data will be described. As an example, as shown in FIG. **4**, person (P**1**) **120** may have a token **130**. Person **120** may be shown on display screen **400** of display device **112** to a security person **110**. As previously described, person **120** may be displayed to have a token **130** based upon the determined position data of the token **130** being associated with person **120** by the intrusion detector **102** such that the token **130** is displayed with person **120** on the display screen **400**. Further, biometric data may also be utilized.

As an example, the intrusion detector **102** based upon facial recognition, height, and weight as calculated from the video stream **104** may compare this to previously stored biometric data for the person assigned to the token **130** with respect to facial recognition, height, and weight. Thus, it may be determined whether the person **120** has substantially the same face, same height, same weight, etc., as stored for the assigned person. In particular, if the biometric data for the person assigned to the token **130** matches, then person **120** is displayed as authorized.

For example, with brief additional reference to FIG. **5**, which is a table **500** showing collected data by the intrusion detector, table **500** may include person P**1** **120** having: a token identifier **510** set to "yes"; position identifier **512** set to "correct" indicating that the token is associated with the correct position data for the person P**1** **120**; and biometric data **514** set to "matches" indicating matching biometric data—such that intrusion detector **102** identifies the person **120** as authorized **516**. For example, the person **120** may be shown in full lines and/or colored green, etc., on the display screen **400**.

As another example, as shown in FIG. **4**, person (P**2**) **122** may have a token **130**. Person **122** may be shown on display screen **400** of the display device **112** to a security person **110**. As previously described, person **122** may be displayed to have a token **130** based upon the determined position data of the token **130** being associated with person **122** by the intrusion detector **102** such that the token **130** is displayed with person **122** on the display screen **400**. Further, biometric data may also be utilized.

As an example, the intrusion detector **102** based upon facial recognition, height, and weight biometric data as calculated from the video stream **104** may compare this to previously stored biometric data for the person assigned to the token **130** with respect to facial recognition, height, and weight. Thus, intrusion detector **102** may determine whether person **122** has substantially the same face, same height, same weight, etc., as stored for the assigned person. In particular, if the biometric data for the person assigned to the token **130** does not match (e.g., the person has a different face, height, weight, etc.), then person **122** may be displayed as not authorized.

For example, with brief reference to FIG. **5**, which is a table **500** showing collected data by the intrusion detector, table **500** may include person P**2** **122** having: a token identifier **510** set to "yes"; position identifier **512** set to "correct" indicating that the token is associated with the correct position data for the person P**2** **122**; and biometric data **514** set to "not matching" indicating biometric data that does not match—such that intrusion detector **102** identifies the person **120** as not authorized **516**. For example, the person **122** may be shown in dashed lines and/or by a certain color (e.g., red for unauthorized) on the display screen **400**. In this example, there is a high probability that an unauthorized person has the token **130**.

In addition, a level of confidence may be utilized (e.g., fuzzy authorization). In this example, person P**2** has a token **130**, but the biometric data **514** measured is indicative of not matching the authorized person that the token **130** is supposed to be carried by. In particular, as an example, P**2**'s face may not be recognizable by the system and P**2**'s height and weight may be off by 15% in comparison to the values stored for the authorized person. In this instance, there is a high probability that the person is unauthorized—but this determination cannot be made for certain. Therefore, a level of confidence as to whether the person is authorized is assigned and may be shown by a bar next to the person on the display screen **400**. As an example, a bar **123** may be displayed next to the person (P**2**) indicating the level of confidence. In this example, the level of confidence is low (e.g., 30%) because there is a high probability based upon the measurable biometric data that the person (P**2**) is not the person authorized to be carrying the token. It should be appreciated that a wide variety of different types of level of confidence measurements (e.g., based upon biometric data) may be utilized and that a variety of different types of displays may be utilized—and that these example are merely illustrative.

As yet another example, as shown in FIG. **4**, person (P**3**) **124** may not have a token. Person **124** may be shown on display screen **400** of display device **112** to a security person **110** based upon video stream **104**. Because person **124** does not have a token, they may be automatically display as unauthorized. For example, person **124** may be shown in dashed lines and/or by a certain color (e.g., red for unauthorized) on the display screen **400**.

However, even though the person does not have a token, biometric data may still be utilized to identify the person. For example, the intrusion detector **102** based upon facial recognition, height, and weight as calculated from the video stream **104** may compare this to previously stored biometric for a person that may be authorized. Thus, it may be determined whether the person has substantially the same face, same height, same weight, etc., of an authorized person, or not, in which case they are not authorized. For example, with brief reference to FIG. **5**, table **500** may include person P**3** **124** having: a token identifier **510** set to "no"; position identifier **512** set to "none" indicating that there is no token associated with person **124**; biometric data **514** set to "not matching" indicating biometric data that does not match—such that intrusion detector **102** identifies the person **120** as not authorized **516**. On the other hand, even though the person does not have a token, the person may be identified as typically authorized if the intrusion detector **102** determines if biometric data for facial recognition, height, and weight calculated from the video stream **104** matches biometric data associated with a stored authorized person.

Further, it should be appreciated that the intrusion detector **102** may still estimate the position of person **124** without a token, based upon the previously described triangulation methodology and based upon the already estimated positions of the tokens **130**, persons **122** and **124**, and the predefined positions of all the nodes **150**.

Therefore, aspects of the invention relate to an intrusion detector **102** that receives video stream data **104** from a camera **106** in combination with token data **108** such that it can be determined by a security person **110** viewing the video stream data on a display device **112** whether a person is carrying a token **103**. If a person is not carrying a token, they may automatically be displayed as unauthorized (e.g., in dashed lines and/or colored red, etc.) and the security person **110** can take appropriate action. On the other hand, a person **120** may determined to be authorized by their possession of a token **130** and may be displayed to security personnel **110** as such (e.g., in full lines and/or colored green, etc.).

Examples have been provided in which a token **130** may be smart wireless device which can have its location determined by communicating with nodes **150** in an ad-hoc mesh network. Using object detection methods on the video stream data **104** from a camera **106**, all persons can be detected regardless of their possession of tokens **130**. It should be appreciated that any suitable camera may be utilized, such as, an infrared (IR) camera, etc.

Additionally, intrusion detector **102** may create a list of people within a space and cross-correlate that with the list of authorized people (e.g., persons **120** and **122** in FIG. **1**). Areas in which unauthorized people (e.g., person **124** in FIG. **1**) are located may generate an alarm (e.g., sound alarms or visual alarms) to be brought to the attention of security personnel **110**. As a previously described example, unauthorized people could be highlighted on the video stream (e.g., in red or dashed lines). Further, as previously described, when biometric data is associated with tokens **130** as implemented by intrusion detector **102**, inappropriate or stolen tokens may be automatically identified by checking stored biometric data associated with the token against detected biometric data (e.g., height, weight, or facial recognition) for the person carrying the token. Also, further biometric data streams (e.g., audio, pressure, movement, etc.) from other sources may also be utilized.

Additionally, it should be appreciated that although the display device **112** examples of FIG. **1** and FIG. **4** show 2D examples of displaying persons **120**, **122**, **124** and described different types of light and solid/dashed presentation techniques, that these are merely simple examples. Any type of display may be utilized: 2D, 3D, computer graphics, cartoon, digital, real-time video with computer graphic techniques, etc.

Further, it should be appreciated that the previously described example of a room **160** in which nodes **150** communicate to implement position determination techniques that are utilized by intrusion detector **102** to identify authorized and unauthorized people to security is just one example. These techniques may be implemented by nodes at a variety of different locations (walls, ceilings, floors, tables, furniture, other locations, etc.) throughout buildings (e.g., halls, rooms, auditoriums, airport, etc.) or outside buildings (e.g., parking lot, walkways, etc.).

An example of the utilization of the previously-described techniques may be in an airport scenario. In the airport scenario, with FIG. **1** as an illustration, a person may approved at a security check-point, at which point they are given a token **130** (e.g., person **120** and **122**) to walk through the building **160** to the airplane, at which point they then can hand-back the token upon the boarding of the airplane. Unauthorized people (without tokens **130**, e.g., person **124**) could be tracked by security personnel **110** on the display device **112** and authorized people **120** and **122**, with tokens **130**, could be found if needed (e.g., if they are late for their flight).

Aspects of the invention provide advantages in that: authorization is tracked constantly (not just at entry points); biometric data is continuously checked; and human interaction is reduced (e.g., a security guard is only required when a person is shown on the display device as unauthorized and/or an alarm is set off). Further, biometric matching is simplified because particular singular people are matched against a singular set of known data for that particular person. Moreover, an attack by the insertion of a fake video feed (e.g., a replay of earlier footage) cannot be utilized with aspects of the invention because the fake video would not correlate with the detected scene of authorized persons carrying tokens provided by the system.

It should be appreciated that aspects of the invention previously described may be implemented in conjunction with the execution of instructions by processors **142**, **202**, **210** of intrusion detectors **102**, nodes **150**, and tokens **130**. Particularly, circuitry of the intrusion detectors, nodes, and tokens, including but not limited to processors, may operate under the control of a program, routine, or the execution of instructions to execute methods or processes in accordance with embodiments of the invention. For example, such a program may be implemented in firmware or software (e.g. stored in memory and/or other locations) and may be implemented by processors and/or other circuitry. Further, it should be appreciated that the terms processor, microprocessor, circuitry, controller, etc., refer to any type of logic or circuitry capable of executing logic, commands, instructions, software, firmware, functionality, etc

It should be appreciated that when the intrusion detectors **102**, nodes **150**, and tokens **130** are mobile or wireless devices that they may communicate via one or more wireless communication links through a wireless network that are based on or otherwise support any suitable wireless communication technology. For example, in some aspects the intrusion detectors, nodes, and tokens and other devices may associate with a network including a wireless network. In some aspects the network may comprise a body area network or a personal area network (e.g., an ultra-wideband network). In some aspects the network may comprise a local area network or a wide area network. A wireless device may support or otherwise use one or more of a variety of wireless communication technologies, protocols, or standards such as, for example, CDMA, TDMA, OFDM, OFDMA, WiMAX, and Wi-Fi. Similarly, a wireless device may support or otherwise use one or more of a variety of corresponding modulation or multiplexing schemes. A wireless device may thus include appropriate components (e.g., air interfaces) to establish and communicate via one or more wireless communication links using the above or other wireless communication technologies. For example, a device may comprise a wireless transceiver with associated transmitter and receiver components (e.g., a transmitter and a receiver) that may include various components (e.g., signal generators and signal processors) that facilitate communication over a wireless medium. As is well known, a mobile wireless device may therefore wirelessly communicate with other mobile devices, cell phones, other wired and wireless computers, Internet web-sites, etc.

The techniques described herein can be used for various wireless communication systems such as Code Division Multiple Access (CDMA), Time division multiple access (TDMA), Frequency Division Multiple Access (FDMA), Orthogonal Frequency-Division Multiple Access (OFDMA), Single Carrier FDMA (SC-FDMA) and other systems. The terms "system" and "network" are often used interchangeably. A CDMA system can implement a radio technology such as Universal Terrestrial Radio Access (UTRA), CDMA2000, etc. UTRA includes Wideband-CDMA (W-CDMA) and other variants of CDMA. CDMA2000 covers Interim Standard (IS)-2000, IS-95 and IS-856 standards. A TDMA system can implement a radio technology such as Global System for Mobile Communications (GSM). An OFDMA system can implement a radio technology such as Evolved Universal Terrestrial Radio Access; (Evolved UTRA or E-UTRA), Ultra Mobile Broadband (UMB), Institute of Electrical and Electronics Engineers (IEEE) 802.11 (Wi-Fi), IEEE 802.16 (WiMAX), IEEE 802.20, Flash-OFDM™, etc. Universal Terrestrial Radio Access (UTRA) and E-UTRA are part of Universal Mobile Telecommunication System (UMTS). 3GPP Long Term Evolution (LTE) is an upcoming release of UMTS that uses E-UTRA, which employs OFDMA on the downlink and SC-FDMA on the uplink. UTRA, E-UTRA, UMTS, LTE and GSM are described in documents from an organization named "3rd Generation Partnership Project" (3GPP). CDMA2000 and UMB are described in documents from an organization named "3rd Generation Partnership Project 2" (3GPP2).

The teachings herein may be incorporated into (e.g., implemented within or performed by) a variety of apparatuses (e.g., devices). For example, one or more aspects taught herein may be incorporated into a phone (e.g., a cellular phone), a personal data assistant ("PDA"), a tablet, a mobile computer, a laptop computer, a tablet, an entertainment device (e.g., a music or video device), a headset (e.g., headphones, an earpiece, etc.), a user I/O device, a computer, a server, a point-of-sale device, an entertainment device, a set-top box, or any other suitable device. These devices may have different power and data requirements

In some aspects, a wireless device may comprise an access device (e.g., a Wi-Fi access point) for a communication system. Such an access device may provide, for example, connectivity to another network (e.g., a wide area network such as the Internet or a cellular network) via a wired or wireless communication link. Accordingly, the access device may enable another device (e.g., a Wi-Fi station) to access the other network or some other functionality. In addition, it should be appreciated that one or both of the devices may be portable or, in some cases, relatively non-portable.

Those of skill in the art would understand that information and signals may be represented using any of a variety of different technologies and techniques. For example, data, instructions, commands, information, signals, bits, symbols, and chips that may be referenced throughout the above description may be represented by voltages, currents, electromagnetic waves, magnetic fields or particles, optical fields or particles, or any combination thereof.

Those of skill would further appreciate that the various illustrative logical blocks, modules, circuits, and algorithm steps described in connection with the embodiments disclosed herein may be implemented as electronic hardware, computer software, or combinations of both. To clearly illustrate this interchangeability of hardware and software, various illustrative components, blocks, modules, circuits, and steps have been described above generally in terms of their functionality. Whether such functionality is implemented as hardware or software depends upon the particular application and design constraints imposed on the overall system. Skilled artisans may implement the described functionality in varying ways for each particular application, but such implementation decisions should not be interpreted as causing a departure from the scope of the present invention.

The various illustrative logical blocks, modules, and circuits described in connection with the embodiments disclosed herein may be implemented or performed with a general purpose processor, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field programmable gate array (FPGA) or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein. A general purpose processor may be a microprocessor, but in the alternative, the processor may be any conventional processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices, e.g., a combination of a DSP and a microprocessor, a plurality of microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration.

The steps of a method or algorithm described in connection with the embodiments disclosed herein may be embodied directly in hardware, in a software module executed by a processor, or in a combination of the two. A software module may reside in RAM memory, flash memory, ROM memory, EPROM memory, EEPROM memory, registers, hard disk, a removable disk, a CD-ROM, or any other form of storage medium known in the art. An exemplary storage medium is coupled to the processor such the processor can read information from, and write information to, the storage medium. In the alternative, the storage medium may be integral to the processor. The processor and the storage medium may reside in an ASIC. The ASIC may reside in a user terminal. In the alternative, the processor and the storage medium may reside as discrete components in a user terminal.

In one or more exemplary embodiments, the functions described may be implemented in hardware, software, firmware, or any combination thereof. If implemented in software as a computer program product, the functions may be stored on or transmitted over as one or more instructions or code on a computer-readable medium. Computer-readable media includes both computer storage media and communication media including any medium that facilitates transfer of a computer program from one place to another. A storage media may be any available media that can be accessed by a computer. By way of example, and not limitation, such computer-readable media can comprise RAM, ROM, EEPROM, CD-ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other medium that can be used to carry or store desired program code in the form of instructions or data structures and that can be accessed by a computer. Also, any connection is properly termed a computer-readable medium. For example, if the software is transmitted from a web site, server, or other remote source using a coaxial cable, fiber optic cable, twisted pair, digital subscriber line (DSL), or wireless technologies such as infrared, radio, and microwave, then the coaxial cable, fiber optic cable, twisted pair, DSL, or wireless technologies such as infrared, radio, and microwave are included in the definition of medium. Disk and disc, as used herein, includes compact disc (CD), laser disc, optical disc, digital versatile disc (DVD), floppy disk and blu-ray disc where disks usually reproduce data magnetically, while discs reproduce data optically with lasers. Combinations of the above should also be included within the scope of computer-readable media.

The previous description of the disclosed embodiments is provided to enable any person skilled in the art to make or use the present invention. Various modifications to these embodiments will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other embodiments without departing from the spirit or scope of the invention. Thus, the present invention is not intended to be limited to the embodiments shown herein but is to be accorded the widest scope consistent with the principles and novel features disclosed herein.

What is claimed is:

1. An intrusion detector comprising:

an interface to receive video stream data from a camera and token data; and

a processor to execute operations including:

receiving the video stream data and the token data, the token data comprising position data associated with a token, the position data being calculated using triangulation based on a plurality of nodes with known locations; and

determining whether a person in the video stream data is carrying the token based upon the position data being associated with the token and with the person;

wherein, when the person in the video stream data is determined to not be carrying the token associated with the calculated position data, identifying the person in the video stream data as unauthorized.

2. The intrusion detector of claim **1**, further comprising a display device, wherein, the unauthorized person is displayed on the display device as unauthorized.

3. The intrusion detector of claim **1**, wherein, if the person is determined to be carrying the token, further comprising identifying the person as authorized.

4. The intrusion detector of claim **3**, further comprising a display device, wherein, the authorized person is displayed on the display device as authorized.

5. The intrusion detector of claim **1**, wherein the token data comprises an identification signal received from the token.

6. The intrusion detector of claim **1**, wherein, if the person is determined to be carrying the token, the processor further executes operations including comparing measured biometric data of the person carrying the token to stored biometric data for the person assigned to the token.

7. The intrusion detector of claim **6**, wherein, if the measured biometric data of the person carrying the token matches the stored biometric data for the person assigned to the token, the processor further executes operations including identifying the person as authorized.

8. The intrusion detector of claim **7**, further comprising a display device, wherein, the authorized person is displayed on the display device as authorized.

9. The intrusion detector of claim **6**, wherein, if the measured biometric data of the person carrying the token does not match the stored biometric data for the person assigned to the token, the processor further executes operations including identifying the person as unauthorized.

10. The intrusion detector of claim **9**, further comprising a display device, wherein, the unauthorized person is displayed on the display device as unauthorized.

11. The intrusion detector of claim **6**, wherein the measured biometric data includes facial recognition.

12. The intrusion detector of claim **7**, wherein the measured biometric data includes at least one of height or weight.

13. A method comprising:

receiving video stream data from a camera and token data, the token data comprising position data associated with a token, the position data being calculated using triangulation based on a plurality of nodes with known locations; and

determining whether a person in the video stream data is carrying the token based upon the position data being associated with the token and with the person;

wherein, when the person in the video stream data is determined to not be carrying the token associated with the calculated position data, identifying the person in the video stream data as unauthorized.

14. The method of claim **13**, further comprising displaying the unauthorized person on a display device as unauthorized.

15. The method of claim **13**, wherein, if the person is determined to be carrying the token, further comprising identifying the person as authorized and displaying the authorized person on a display device as authorized.

16. The method of claim **13**, wherein the token data comprises an identification signal received from the token.

17. The method of claim **13**, wherein, if the person is determined to be carrying the token, further comprising, comparing measured biometric data of the person carrying the token to stored biometric data for the person assigned to the token.

18. The method of claim **17**, wherein, if the measured biometric data of the person carrying the token matches the stored biometric data for the person assigned to the token, further comprising identifying the person as authorized and displaying the authorized person on a display device as authorized.

19. The method of claim **17**, wherein, if the measured biometric data of the person carrying the token does not match the stored biometric data for the person assigned to the token, further comprising identifying the person as unauthorized and displaying the unauthorized person on a display device as unauthorized.

20. The method of claim **17**, wherein the measured biometric data includes at least one of facial recognition, height, or weight.

21. A non-transitory computer-readable medium comprising code which, when executed by a processor of an intrusion detector, causes the processor to perform a method comprising:

receiving video stream data from a camera and token data, the token data comprising position data associated with a token, the position data being calculated using triangulation based on a plurality of nodes with known locations; and

determining whether a person in the video stream data is carrying the token based upon the position data being associated with the token and with the person;

wherein, when the person in the video stream data is determined to not be carrying the token associated with the calculated position data, identifying the person in the video stream data as unauthorized.

22. The non-transitory computer-readable medium of claim **21**, further comprising code for displaying the unauthorized person on a display device as unauthorized.

23. The non-transitory computer-readable medium of claim **21**, wherein, if the person is determined to be carrying the token, further comprising code for identifying the person as authorized and displaying the authorized person on a display device as authorized.

24. The non-transitory computer-readable medium of claim **21**, wherein the token data comprises an identification signal received from the token.

25. The non-transitory computer-readable medium of claim **21**, wherein, if the person is determined to be carrying the token, further comprising code for comparing measured biometric data of the person carrying the token to stored biometric data for the person assigned to the token.

26. The non-transitory computer-readable medium of claim **25**, wherein, if the measured biometric data of the person carrying the token matches the stored biometric data for the person assigned to the token, further comprising code for identifying the person as authorized and displaying the authorized person on a display device as authorized.

27. The non-transitory computer-readable medium of claim **25**, wherein, if the measured biometric data of the person carrying the token does not match the stored biometric data for the person assigned to the token, further comprising code for identifying the person as unauthorized and displaying the unauthorized person on a display device as unauthorized.

28. The non-transitory computer-readable medium of claim **25**, wherein the measured biometric data includes facial recognition.

29. The non-transitory computer-readable medium of claim **25**, wherein the measured biometric data includes at least one of height or weight.

30. An intrusion detector comprising:

means for receiving video stream data from a camera and token data, the token data comprising position data associated with a token, the position data being calculated using triangulation based on a plurality of nodes with known locations; and

means for determining whether a person in the video stream data is carrying the token based upon the position data being associated with the token and with the person;

wherein, when the person in the video stream data is determined to not be carrying the token associated with the calculated position data, identifying the person in the video stream data as unauthorized.

31. The intrusion detector of claim **30**, further comprising means for displaying the unauthorized person as unauthorized.

32. The intrusion detector of claim **30**, wherein, if the person is determined to be carrying the token, further comprising means for identifying the person as authorized and displaying the authorized person as authorized.

33. The intrusion detector of claim **30**, wherein the token data comprises an identification signal received from the token.

34. The intrusion detector of claim **30**, wherein, if the person is determined to be carrying the token, further comprising means for comparing measured biometric data of the person carrying the token to stored biometric data for the person assigned to the token.

35. The intrusion detector of claim **34**, wherein, if the measured biometric data of the person carrying the token matches the stored biometric data for the person assigned to the token, further comprising means for identifying the person as authorized and displaying the authorized person as authorized.

36. The intrusion detector of claim **34**, wherein, if the measured biometric data of the person carrying the token does not match the stored biometric data for the person assigned to the token, further comprising means for identifying the person as unauthorized and displaying the unauthorized person as unauthorized.

37. The intrusion detector of claim **34**, wherein the measured biometric data includes at least one of facial recognition, height, or weight.

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